DOCUMENT RESUME

ED 085 249 SE 016 985

AUTHOR Waldner, Suzanne; Evert, Michael T.
TITLE Junior High Mathematics Activities and Problems in Environmental Education: A Teacher's Guide.
INSTITUTION Milwaukee Public Schools, Wis. Div. of Curriculum and Instruction.
PUB DATE 72
NOTE 56p.

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS Curriculum; Environment; *Environmental Education; *Guides; Instructional Materials; *Interdisciplinary Approach; Junior High Schools; Mathematical Applications; *Mathematics Education; Problem Solving; *Secondary School Mathematics
IDENTIFIERS Elementary Secondary Education Act Title III; ESEA Title III

ABSTRACT

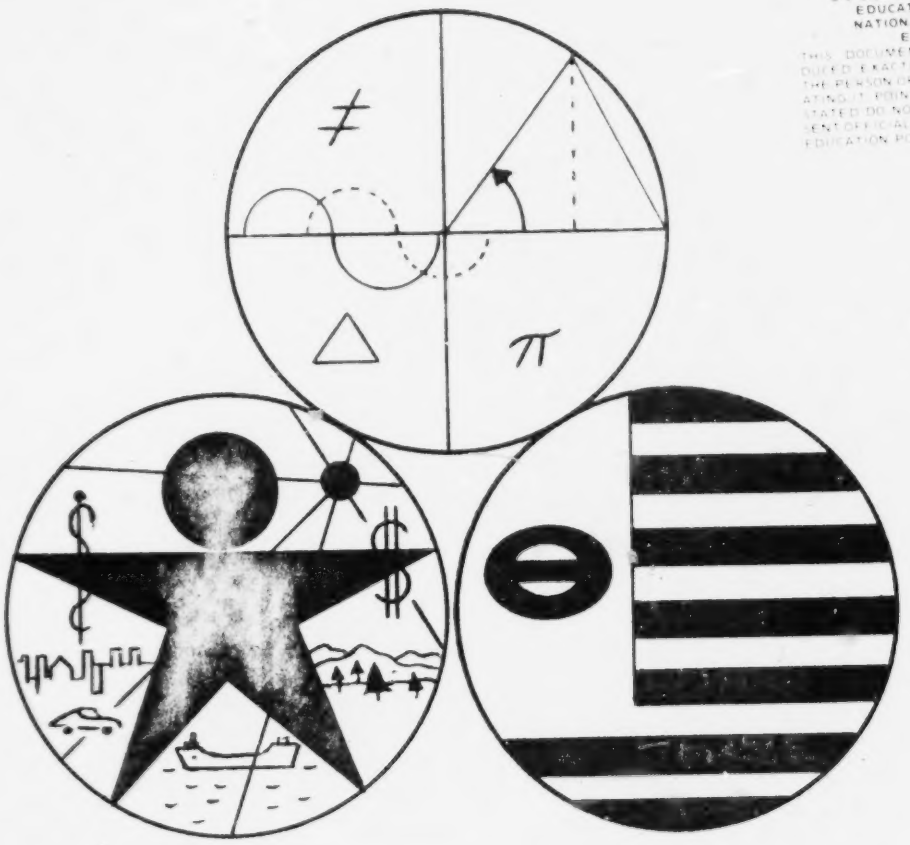
As its primary function, this publication is to provide ideas and suggestions for ways that junior high school mathematics teachers can include environmental concepts as a meaningful component of the ongoing instructional program in mathematics. It includes suggestions for activities and projects as well as environmentally-oriented problems which correlate with the mathematics concepts of the junior high program. Some activities require work outside of the classroom, but many may be used in presenting mathematical concepts. This work was prepared under an ESEA Title III contract. (JP)

milwaukee public schools

JUNIOR HIGH MATHEMATICS

ED 085249

U.S. DEPARTMENT OF HEALTH
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY



ACTIVITIES AND PROBLEMS IN ENVIRONMENTAL EDUCATION

FILMED FROM BEST AVAILABLE COPY

ED 085249

JUNIOR HIGH MATHEMATICS
ACTIVITIES AND PROBLEMS
IN ENVIRONMENTAL EDUCATION
A TEACHER'S GUIDE

Developed Under Provisions of

ESEA TITLE III, SECTION 306,

ENVIRONMENTAL EDUCATION PROGRAM

Department of Elementary and Secondary Education

Division of Curriculum and Instruction

Milwaukee Public Schools

1972

FORWARD

As its primary function, this publication is to provide ideas and suggestions for ways that junior high school mathematics teachers can include environmental concepts as a meaningful component of the ongoing instructional program in mathematics. It specifically includes suggestions for activities and projects as well as environmentally oriented problems which correlate with the mathematics concepts of the junior high program. Special recognition should be given to Suzanne Waldner and Michael Evert who received special training in this area and were the primary authors of this resource booklet. Mr. Bruce Bamberg also deserves recognition for his technical advice and assistance to this project. Hopefully, through well planned use of this booklet by mathematics teachers, the students of Milwaukee will be more aware of and concerned about the environmental issues of today and their impact on tomorrow.

Paul J. Hagerty, Curriculum Specialist
Mathematics

Frisby D. Smith, Executive Director
Department of Elementary and Secondary Education

Bernard J. Weiss, Assistant Superintendent
Division of Curriculum and Instruction

Dwight Teel, Deputy Superintendent

Richard P. Gousha, Superintendent of Schools

TABLE OF CONTENTS

FORWARD i

INTRODUCTION. ii

SOME ENVIRONMENTAL CONCEPTS iii

MAJOR CONCEPT CATEGORIES APPLICATION CHECKLIST. iv

PROJECTS AND ACTIVITIES 1

PUZZLES 10

WHOLE NUMBERS 12

RATIONAL NUMBERS: FRACTIONS 15

RATIONAL NUMBERS: DECIMALS. 18

PERIMETER, AREA 20

RATIO, PROPORTION, PERCENT. 21

GRAPHING AND STATISTICAL MEASURES 29

ANSWERS 37

INTRODUCTION

This booklet was produced as a result of a workshop on environmental education. It is not intended to solve any environmental problems but rather to provide an awareness through mathematics. Activities and problems are presented merely as a supplement to, not a substitute for the existing curriculum. Some activities will require work outside of the classroom, but many may be used merely to present mathematical concepts.

Most of the problems are original. However, several are taken from Pollution, a pamphlet published by the Wisconsin Department of Public Instruction. We feel that every teacher should have a copy of this pamphlet, but since this is not practical, we have incorporated some of the better problems into our booklet. These problems are indicated by (*). We have tried to choose problems that are meaningful for our children.

Obviously not all these examples will motivate students and teachers into action, but if one problem should trigger enthusiasm, we hope that you as a teacher will be able to channel this enthusiasm into constructive action. We have a responsibility not only as mathematics teachers but also as human beings to help our students see the folly of a society where the quality of life is judged by the quantity of garbage.

Suzanne Waldner
Peckham Junior High

Michael T. Evert
John Muir Junior High

SOME ENVIRONMENTAL CONCEPTS

1. Energy from the sun, the basic source of all energy, is converted through plant photosynthesis into a form all living things can use for life processes.

2. All living organisms interact among themselves and their environment, forming an intricate unit called an ecosystem.

3. Environmental factors are limiting on the numbers of organisms living within their influence. Thus, each environment has a carrying capacity.

4. An adequate supply of pure water is essential to life.

5. An adequate supply of clean air is essential to life.

6. Natural resources are not equally distributed over the earth or over time and greatly affect the geographic conditions and quality of life.

7. Factors such as facilitating transportation, economic conditions, population growth, and increased leisure time have a great influence on changes in land use and centers of population density.

8. Cultural, economic, social, and political factors determine the status of man's values and attitudes toward his environment.

9. Man has the ability to manage, manipulate, and change his environment.

    a. Short-term economic gains may produce long-term environmental losses.

    b. Individual acts, duplicated or compounded, produce significant environmental alterations over time.

    c. Private ownership must be regarded as a stewardship and should not encroach upon or violate the individual right of others.

MAJOR CONCEPT CATEGORIES APPLICATION CHECKLIST

Subject Mathematics Grade level 7 & 8 Unit Divisions	1 Sun Energy	2 Interaction of Ecosystem	3 Carrying Capacity	4 Water Supply	5 Air Supply	6 Resource Distribution	7 Influences for change	8 Cultural, Economic Social, political factor	9 Manipulation	9a Short term-Long term factors	9b Individual Alterations	9c Stewardship and Rights			See list for Concepts
Ancient Numeration Systems															
Other Numeration Systems															
Properties of Whole Numbers			X	X	X			X		X	X				
Properties of Decimals			X	X				X							
Properties of Fractions			X	X				X							
Percent			X	X	X	X		X	X	X	X				
Perimeter, Area, Volume			X			X									
Informal Geometry						X									

PROJECTS AND ACTIVITIES

*1. Make plans to take a count of cars traveling certain routes, at certain hours, on various days in your community.

Suggestions:

Go to the location you have chosen. Count the cars traveling in one direction and the number of passengers in each car. Do this for ½ hour during a morning rush hour, ½ hour during an evening rush hour, and ½ hour during a midday hour. Teams could be established for collection.

Determine how many days you will do this and vary your days so that some are weekdays and some are weekends.

When you arrive at what you feel is a fair sampling, determine how many fewer cars would have been needed if each car would have carried 3 passengers.

Determine what per cent of the cars carried only 1 person; 2 persons; 3 persons; more than 3 persons.

What conclusions can you form as an individual or as a group carrying out this project? Can you use these conclusions to make some recommendations to your own family (families)? To the staff of your school? To the members of your community? To your traffic department?

2. Answer these questions concerning the amount of lead released by automobiles:

a. If the amount of lead released into the air by the use of leaded gas is about 410,000,000 pounds each year, and in 1970, there were 109,000,000 registered cars and trucks in the U.S., about how much lead is released per car per year?

b. If the population of the U.S. in 1970 was 205,000,000 how much lead is released per person?

c. If the number of cars doubles by the year 2040, how much lead will be released in that year?

For Discussion:

-- Would the use of non-leaded gas reduce the air pollution by an appreciable amount? Investigate the amount of non-leaded gas sold by major companies. Do transportation companies (bus, taxi,...) use non-leaded gas? Check the police department, telephone company...

-- Many people commute to work, a large number of which are alone in their car. What methods would you suggest to cut down on the number of cars used to commute? Would this help cut down the amount of air pollution appreciably?

-- Take a survey of teachers and parents and determine how many use non-leaded gas. If they do not use non-leaded gas, ask why not.

3. The demand for electricity is increasing at an alarming rate. The increase between 1968 and 1969 was at a rate of 7.9%. The total output of power for 1969 was twice what it was for 1959 and 6 times as much as for 1944. In peak demand periods we may be faced with an energy shortage. What could we do without?

   a. Have each student take a survey of the number and kind of electrical devices they have in their homes and in one other home. (The average is about 11 per family.) After each appliance, have the student indicate whether or not it is necessary.

   b. Combine all information to find:

      1. average number of devices per home
      2. average number of necessary devices
      3. average number of unnecessary devices

   c. Make a list of all electrical devices advertised on T.V. that are not on your list.

   d. Determine, with the help of the Electric Company, the cost of running the appliances for one month. Compare the cost of the necessary and unnecessary items.

   e. Using a list of kilowatt hours for each appliance, compute the amount of energy saved per family and by the entire class if no home would use the unnecessary items.

4. Phosphates in water, from the use of detergents, increase the amount of algae in our rivers and lakes.

   a. Have each student copy the listing of contents on their family laundry detergent; also include the weight of the package.

   b. Based on the weight of the box and on the percentages given, figure the amount of phosphate in each box.

   c. From the amount of phosphate determined in part B, decide how many people in class would have to use a low phosphate detergent to show significant decrease in the phosphate level.

Note:

The words "significant decrease" may need explanation. Several cities and states have put restrictions on the amount of phosphate in soap. By January 1, 1973, the state of Indiana will require that no laundry soap be sold that contains over 4% phosphate (by weight). By June, 1972, both the cities of Chicago and Akron, Ohio will allow no phosphate in soap. It may be interesting to investigate how these places will enforce these controls.

Project:

Conduct a survey of families in the area to see how many are using a low phosphate detergent. Check local food stores to see how the low phosphate detergents are selling.

5. Phosphate free detergents cost more than many regular detergents.

Have a portion of the class formulate a mathematical argument for using phosphate free detergents. Examine these possibilities:

a. amount of detergent used
b. cost per ounce of detergent
c. cost per load of wash
d. method of removing phosphate in water

Have the rest of the class give a mathematical counter-argument. Examine these possibilities:

a. ability to use same suds over
b. initial cost
c. cleaner wash (cost of clothes)
d. economic possibilities of harvesting algae for food

Evidence could be in the form of charts, graphs or number facts. Check the results with a survey of sales for both products.

6. a. Make a scale drawing of the shape of the playground including land covered by asphalt, grass, and concrete.

b. Determine the following:

1. area of playground in square feet and acres
2. area covered by grass in square feet and acres
3. area covered by asphalt in square feet and acres
4. area covered by concrete in square feet and acres

c. Form the following ratios and reduce to lowest terms.

1. $\frac{\text{area of asphalt}}{\text{area of total plot}}$ (in acres)

2. $\frac{\text{area of grass}}{\text{area of concrete}}$ (sq. feet)

3. $\frac{\text{area of grass}}{\text{area of plot}}$ (in acres)

4. $\frac{\text{area of grass}}{\text{area of plot}}$ (sq. feet)

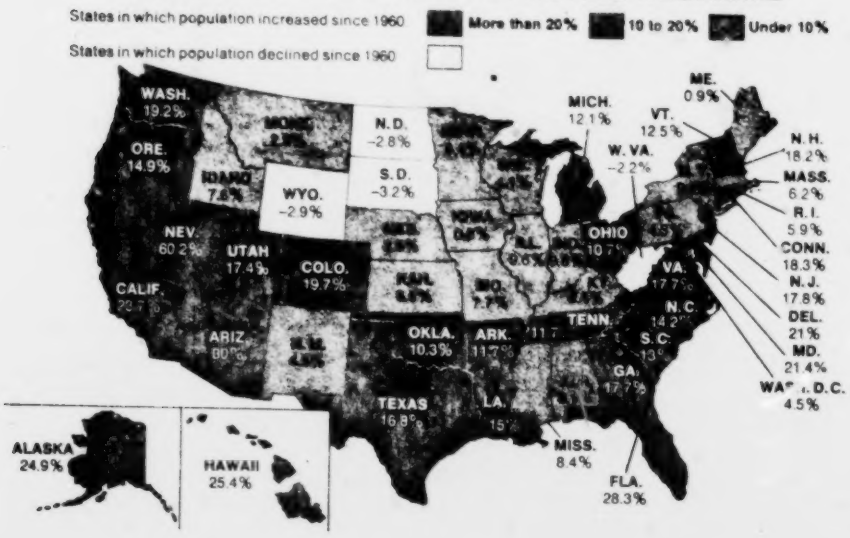
Materials needed:

graph paper

straight edge

tape measure (100 ft. minimum)

NATION'S POPULATION IS STILL MOVING WESTWARD



Using the information on the map and a report on the 1970 census, determine the number of people the following states gained or lost:

Nevada, California, Arizona, Florida, Maryland, Delaware, New York, Wisconsin, Kansas, Montana, North Dakota and Wyoming.

Illustrate the increase or decrease in populations for each state on the above list by a bar graph or a line graph.

What problems do you see being created for states such as Nevada, California, Arizona, Florida, Maryland, and Delaware? How would the problems for North Dakota, South Dakota, Wyoming, and West Virginia differ from those in the above named states?

Color in an outline map of the United States using the following key to illustrate the information shown on the map above.

More than 50%	color black
30-49.9%	color grey
25-29.9%	color red
20-24.9%	color orange

10-19.9%	color brown
5-9.9%	color green
0-4.9%	color blue
(-5)-(-.1%)	color white

Compare your map to the original. Does one offer advantages over the other?

If so, what are the advantages or disadvantages?

SUGGESTION: DEVELOP YOUR OWN KEY FOR COLORING A SIMILAR MAP INSTEAD OF USING THE KEY ABOVE.

8. Consider the following data:

   A. 200 gallons of water are required to produce $1.00 worth of paper.

   B. 500 gallons of water are required to produce 1 yard of cloth.

      a. Take a class survey to determine the current quantity of new paper in the students' possession. Compute the value of this paper if each pack costs 15¢ and there are 100 sheets per pack. What is its value in gallons of water?

      b. Have each student compute the yardage of cloth that he has on, using the following approximations:

         a dress = 3 yards
         a shirt, blouse, or skirt = 2 yards
         a pair of slacks = $2\frac{1}{2}$ yards

         What is the value of clothes in gallons of water?

      c. Find the total of water used by each student for clothes and paper. Find total for class.

9. Set aside a small area in front of room as an "island." (4' X 4') Place two students in the area.

   a. Compute the amount of area per student.

   b. Estimate how many students the "island" will hold.

   c. If your estimate is realistic, how much area will each student have? Is your estimate realistic? Change it if it isn't.

   Perform a short experiment to test your results. Start off with two students on the "island" and keep adding two more. As conditions start getting crowded, note the attitude of the islanders towards each other.

   The amount of land is not the only limited quantity. Assume the "island" has 8 gallons of water (gallon = 8 pints) and 20 pounds of food.

   d. If man needs 4 pints of water a day and 3 pounds of food per day, how many days would elapse before 8 people would start to starve or dehydrate? How many days for 16 people?

10. a. Have the class make a list of loud noises in their daily lives. Some might include:

1. Sirens
2. Traffic
3. Live Music
4. Motor Cycles
5. Construction Sites
6. Large Trucks

b. After the list of possible sources of noise is determined, have the students record any of the noises they hear and rate them according to their annoyance levels.

c. Have a representative from the health department come and measure the sounds the students have observed, rating them from high to low. Compare this list with the first list.

For further information, call the Technical Services Division, 278-2538. (A division of Bureau of Consumer Protection and Environmental Health, City of Milwaukee Health Department.)

*11. The birth rate is the number of births per thousand per year.

$$\text{birth rate} = \frac{\text{total number of births per year}}{\text{total population}} \times \frac{1000}{1}$$

The death rate is the number of deaths per thousand per year.

$$\text{death rate} = \frac{\text{total number of deaths per year}}{\text{total population}} \times \frac{1000}{1}$$

Rate of natural increase = birth rate - death rate.

a. Using the information above, complete the table.

Community	Population	Births	Deaths	Birth Rate	Death Rate	Natural Increase	Per cent Increase
Madison	171,500	3115	1059				
Wausau	31,675	562	316				
Green Bay	81,120	1510	645				
Your Community							

b. In Central America, the birth rate is 45 per thousand and the death rate is 11 per thousand.

1. State the birth rate as a per cent.
2. What is the rate of natural increase?
3. What is the per cent of natural increase?
4. At a birth rate of 45 per thousand, how many births would there be out of 238,000 people?

c. By mid-1970 we had about 3.6 billion people in the world.

1. At an annual growth rate of 1.9% what would be the population by mid-1971? By mid-1972?

d. The population of South America in 1965 was 240,000,000. It is predicted to be 624,000,000 by the year 2000.

1. What would the amount of increase be?

2. What would the per cent of increase be?

*12.

AIR POLLUTION IS ONE OF AMERICA'S GREAT PROBLEMS

SOURCES

90 MILLION MOTOR VEHICLES

99% burn gasoline, with pollution from exhaust pipe, crank case, carburetor and gas tank

FACTORIES AND POWER PLANTS

Especially pulp and paper mills, iron and steel mills, refineries, smelters and chemical plants. Over 90% of power plants in 1969 burned coal and oil containing sulphur to generate electricity.

REFUSE DISPOSAL and MISCELLANEOUS

Each person creates about 1800 lbs. of waste per year.

MILLION TONS POLLUTION				
CARBON MONOXIDE	SULPHUR and NITROGEN GASES	HYDRO-CARBONS	PARTICULATES	TOTALS
65	8	18	1	92
12	38	5	17	72
17	2	4	4	27
94	48	27	22	191

TOTAL MILLION TONS AIR POLLUTION PER YEAR

Using the data above, construct a circle graph for each category; motor vehicles, factories and power plants, and refuse and miscellaneous. Construct a bar graph showing total air pollution comparisons between carbon monoxide, sulphur and nitrogen gases, hydrocarbons, and particulates.

PUZZLES

*13. In a set of automobiles, twelve have engines under 300 horsepower, fourteen are blue, thirteen have fiberglass belted tires. Seven are blue and have engines under 300 h.p. Six have fiberglass belted tires and engines under 300 h.p. Five are blue and have fiberglass belted tires. Four are blue and have engines under 300 h.p. and have fiberglass belted tires. What is the number of automobiles in the set?

*14. Ecology is a branch of science dealing with the relations between living organisms and their environment. How many different ways can you read the word "ecology" in the following array, beginning with and "E" and ending with the "Y"? (You may "zig-zag" at right angles.)

NOTE: Before you begin, make an estimate.

*15. Plot the following ordered pairs on graph paper and connect the points in order.

(-4, -5)	(2, 7)
(-3.5, -5.5)	(0, 7)
(-3, -5.8)	(-2, 7)
(-2.5, -5.9)	(-2.5, 6.9)
(-2, -6)	(-3, 6.8)
(0, -6)	(-3.5, 6.5)
(2, -6)	(-4, 6)
(2.5, - 5.9)	(-3.5, 5.5)
(3, -5.8)	(-3, 5.2)
(3.5, -5.5)	(-2.5, 5.1)
(4, -5)	(-2, 5)
(4, 0)	(2, 5)
(4, 6)	(2.5, 5.1)
(3.5, 6.5)	(3, 5.2)
(3, 6.8)	(3.5, 5.5)
(2.5, 6.9)	(4, 6)

Connect (-4, 6) to (-4, -5)

What polluting article does this represent?

*16. Four "polluters" met in Chicago. Their names were Andrew, Robert, Thomas, and Howard. Their "polluting" specialties, one for each, were noise, water, land, and air, but not necessarily respectively. Andrew, Robert, and the land polluter came from the East and the noise polluter came from the West. Their favorite sports were: the air polluter—Tennis, Thomas—Baseball, the noise polluter—football, and the land polluter—baseball. Andy and the land polluter were married and the rest were single. The tennis fan's wife was the noise polluter's sister, and her sister lived with her brother in Los Angeles County. Thomas had been divorced once, then remarried to the same woman, his present wife. Robert had never been married. The tennis fan came from the East, but his wife stayed at home.

Name the air, water, land and noise polluters.

WHOLE NUMBERS

17. Ten percent of the solid waste brought into the Sewerage Commission daily goes into the production of a fertilizer known as Milorganite. ("Mil" for Milwaukee, "orga" for organic, and "nite" for nitrogen.)

The average daily dry weather flow of sewage in Milwaukee is 185 million gallons. To produce 1 ton of Milorganite, it is necessary to treat $1\frac{1}{4}$ million gallons of sewerage. The bagging station has 3 bag pack loaders that fill 50 pound bags at a rate of 21 bags per minute.

a. At the above rate, how many 50 pound bags of Milorganite could be produced in 1 day? (Remember there are 3 bagging machines -- assume the machines to be running 24 hours a day.)

b. From question a., this will produce a total of how many tons per day?

c. Actually only 260 - 280 tons of Milorganite are produced per day. This is different from your answer in question b. Why?

d. In a storage building on Jones Island where the Sewerage Commission is located, 20,000 tons of Milorganite can be stored. How many 50 pound bags would this building hold?

From the sale of Milorganite, approximately $\frac{1}{2}$ of the actual operating costs are recovered for the Sewerage Commission.

18. During rainy weather Milwaukee's waste water treatment plant cannot handle all the water that is pumped into the sewers. This overflow is dumped directly into the lake without treatment.

a. Each person requires 150 gallons of water each day. If the population of Milwaukee and suburbs is 1,085,000, how much water is used each day?

b. On an average dry day, Milwaukee's plant handles 185,000,000 gallons of water. If this is made up of residential (answer a.) and industrial; how much is industrial water?

c. The plant capacity is 200,000,000 gallons per day. How much more water could it handle on a dry day?

*19. Doctor Richard Wang of Milwaukee, reported that his interviews in six months with drug patients in the county hospitals revealed that 37 patients began by using marijuana, 24 used heroin first, 6 began with codeine, 6 began with amphetamines, 5 started on LSD, 3 first used barbiturates, 3 began with morphine, 2 first used cocaine and 1 started by sniffing glue.

How many patients did he interview?

*20. Wisconsin banned DDT in 1970. However, DDT, once in the food chain, circulates for another 15 years. If this is so, and assuming that there is no other source of DDT contamination, in what year would Wisconsin finally be freed from the effects of this chemical?

*21. Erie County in upstate New York is one of the worst air polluted areas in the United States. In a study of the residents of the county it was found that the number of people dying from respiratory diseases is doubling every five years. If in 1960 there were 263 deaths attributed to respiratory dieseases, about how many would there be in 1965? In 1970? In 1980?

*22. When the sulfur dioxide content of the air in New York City rises above .2 parts per million, ten to twenty people die as a result. In the five years, 1965 to 1970, sulfur dioxide reached this level once every ten days.

a. What was the minimum number of people who died in New York City during the five years, 1965 to 1970, as a result of air pollution by sulfur dioxide?

b. What was the maximum number of people who died in New York City during the five years, 1965 to 1970, as a result of air pollution by sulfur dioxide?

23. The amount of trash is increasing twice as fast as the population. We threw away 50 billion cans in 1970. If by 1980, the number is expected to triple, how much will be discarded?

24. In America it costs between $1 to $3 per ton to dispose of trash in an inefficiently operated dump.

At the rate of 5 pounds per person daily, what is the <u>minimum</u> cost of disposing of the trash caused by your class yearly?

25. Scientists and ecologists are worried about the possibility of a break in the 800 mile long trans-Alaska pipeline and the effect it would have on Alaska's wilderness. The pipeline is designed to carry 2,000,000 barrels of oil a day (24 hours). If a break should occur, how much oil would be lost in:

a. 1 hour
b. $\frac{1}{2}$ day
c. 1 week
d. 1 month

What effect do you think an oil break would have on Alaska's wilderness?

26. The volume of pollutants emitted in tons for the State of Wisconsin in 1968 is estimated below. (1 ton = 2000 pounds)

Autos and other vehicles (carbon monoxide, nitrogen oxide)	1,800,000 Tons
Home heating and refuse burning (soot, fly ash, odors)	750,000 Tons
Industry and power generators (fly ash, odors, gases)	400,000 Tons

a. What was the total number of tons of pollutants emitted in Wisconsin in 1968?

b. Express this total in pounds.

RATIONAL NUMBERS: FRACTIONS

27. "Every $7\frac{1}{2}$ seconds a new American is born. He is a disarming little thing, but he begins to scream loudly in a voice that can be heard for 70 years. He is screaming for 26,000 tons of water, 21,000 gallons of gasoline, 10,150 pounds of meat, 28,000 pounds of milk and cream, 9,000 pounds of wheat, and great store houses of all other foods, drinks and tobaccos. These are his lifetime demands of his country and its economy." (Robert and Leona Train Rienow, in Moment In The Sun)

Using the above information:

a. How many new Americans are born each minute? Each hour? Each day? Each week? Each month? Each year? (Assume 1 month = 30 days; 1 year = 365 days)

b. What is the total number of pounds of meat consumed by an American in 1 year? In 1 day? (Express this in fractional form.)

c. If the average cow yields 900 pounds of edible meat, how many cattle will one American consume in his lifetime? (Assume lifespan is 70 years.)

d. What is the average number of pounds of milk and cream each American uses in 1 year? In 1 day?

e. What is the average number of pounds of water each American uses per year? Per day? (Be sure to read the problem carefully.)

*28. If the loss of water in the home is $\frac{1}{2}$ cubic foot in fifteen minutes, how many gallons would be lost per day?

*29. In 1970 it was estimated that about 2/3 of the people of the world go to bed hungry each night. There are approximately $3\frac{1}{2}$ billion people in the world. At that rate approximately how many people go to bed hungry?

30. The area of San Francisco Bay has been reduced in size greatly by land fill projects in the last century. By 1960, diking and filling had reduced the size of the water area from 680 to 400 square miles.

a. The new size of the bay is what fractional part of the original bay? (Express in lowest terms.)

b. What fractional part of the original bay was filled in by 1960?

A report by the Army Corps. of Engineers showed that 2/3 of the bay was less than 12 feet deep.

c. How many square miles (using 1960 figures) are less than 12 feet deep?

d. Approximately $\frac{1}{5}$ of the area of the bay less than 12 feet deep belongs to private owners or local government. This amounts to how many square miles? (Refer back to answer in Part c.)

31. In 1971 approximately 1,000,000 motor vehicles were abandoned on the streets, alleys, vacant lots and highways of the United States. This was only one-seventh of the total number of cars and trucks that Americans disposed of. Note: (Cars and trucks are disposed of by many methods. Abandonment is only one of these methods.)

a. If the population of the United States in 1971 was approximately 200,000,000, how many cars were <u>abandoned</u> for each person?

b. How many cars and trucks were <u>disposed</u> of for each person?

c. If the average number of people per family in a school community is 4, and there are 1,800 different families, how many cars will be <u>abandoned</u> by the school community?

d. How many cars will be <u>disposed</u> of by the school community?

e. What can we do with all of these old junked cars and trucks?

32. In early times epidemics kept the population from increasing too rapidly. In the 17th century the population in Europe was about 110 million.

a. A severe epidemic reduced the population by 10 million. What fraction of the population was this? (Answer in lowest terms.)

b. The population of Florence, Italy was cut in half by the epidemic. If the population was 90,000 how many people died?

c. Hamburg, Germany lost 2/3 of its population during this period. If the population was 780,000 what was the resulting population?

33. Rats can be a terrific problem for cities. The average female rat can have from 8 to 10 litters per year, with each litter having from 8 to 20 young. Within four months the young rats are mature enough to produce their own young.

In the problems below, round off all numbers to the nearest whole number.

a. What is the minimum number of rats produced by one female in one year?

b. What is the maximum number?

c. Not all young will live. In one year, 1/3 will make it to maturity. How many rats will there be? (Base your calculation on the maximum number of rats which you determined in part b.)

d. If 5/8 of the mature rats in part c are females, how many female rats will their be?

e. What is the maximum number of rats produced by the matured females in 5 litters?

34. In 1969 there were 73,728 births in Wisconsin. The same year there were 41,086 deaths. In 1968 the number of births was 73,966 and deaths was 41,064.

a. The number of births in 1969 was greater than the number of deaths for this interval by_____ people?

b. If the total number of births in the United States in 1969 was 3,577,016 and the number of deaths was 1,915,452, Wisconsin's births and deaths represent what percent of the nations total?

Births_____% Deaths_____%

$$\text{Birth rate} = \frac{\text{total number of births per year}}{\text{total population}} \times \frac{1000}{1}$$

$$\text{Death rate} = \frac{\text{total number of deaths per year}}{\text{total population}} \times \frac{1000}{1}$$

c. The population of Wisconsin was 4,334,000 in 1969.

What was Wisconsin's birth rate? _____

What was Wisconsin's death rate? _____

Rate of increase = birth rate - death rate.

d. What was the rate of increase for Wisconsin in 1969?

RATIONAL NUMBERS: DECIMALS

*35. At the time of take off, a four engine jet pours out 88 pounds of air pollutants. If such a plane takes off every minute from an airport, how many pounds of pollutants are poured out into the air in 1 hour? In 1 day? In 1 week? In 1 month? (30 days) In 1 year? (365 days)

Convert all of these answers to tons.

*36. 28,150 pounds of coho salmon were declared unsafe for use from Lake Michigan alone, in March of 1969, because of a high concentration of DDT.

a. This is equivalent to how many tons?

b. If 12 ounces would be considered a normal serving, how many servings went to waste because of the use of this pesticide?

37. Each American uses an annual average of 470 pounds of paper and 205 board feet of lumber. (A board foot of lumber has dimensions 12" X 12" X 1" or in terms of feet 1' X 1' X 1/12')

a. How many total pounds of paper are used by all Americans in a year? (Assume the population of the United States is 205,000,000.)

b. Per year, every American uses the equivalent of _____ boards of lumber which are 6 ft. long and 1 foot wide, and 1 inch thick.

38. Consider the soil bacteria that can reproduce themselves by dividing in half every half hour.

a. How many soil bacteria will be produced by one bacteria in 5 hours?

b. Each bacteria occupies 0.003 cubic units of space and the beginning bacteria is placed in a jar with volume of 20 cubic units. How much space is occupied at the end of 5 hours?

39. Dustfall is the name given to those particles suspended in the air which eventually collect on the ground, windows, laundry, and so forth. In some areas this presents a severe problem. In fact in New York, dustfall levels have reached as high as 30 tons per square mile per month.

a. How many square feet are there in 1 square mile? (1 mile = 5,280 feet)

b. How many pounds are there in 30 tons?

c. How many ounces are there in 60,000 pounds?

d. How many ounces of dust will accumulate in a 1 foot square area in one month?

e. Collect enough dust to equal 1 ounce in weight. (You will have to use the balances in your science class. The bag of a vacuum cleaner would be a good source.)

*40. The following figures are an estimate of what it would cost to accomplish an "acceptable" clean-up over a 5 year period; water, $26 - $29 billion yearly; air in metropolitan areas, $12 - $15 billion yearly; and solid waste disposal, $15 billion yearly.

a. What would such a program cost for 5 years using the minimum figures?

The maximum figures?

b. If our population in those 5 years averaged 210,000,000, what would be the cost per each man, woman, and child for this clean up, based upon the minimum figures?

Based upon the maximum figures?

PERIMETER, AREA

41. Assume a straight section of freeway requires a strip of land 200' wide. If the section of freeway through the city is 6 miles long, find:

a. The total length of this stretch of freeway in feet (1 mile = 5,280 feet).

b. The total length of this stretch of freeway in yards (1 yard = 3 feet).

c. The total area of the land required for this stretch of freeway (in square feet).

d. The total area computed in part c, in sq. yards (1 sq. yard = 9 sq. feet).

e. Assume that all the land taken for the freeway was occupied by people. If on the average, 5 people occupy a lot 40' X 100', about how many people would be displaced by this stretch of freeway?

*42. Los Angeles produces approximately 20,000 tons of air pollution per day.

a. If the area of Los Angeles is about 1,400 sq. miles, what is the potential pollution output per square mile per day?

b. If 1 mile = 12 city blocks, what is the pollution output per square block per day?

c. How many pounds does this equal?

*43. From one square mile of land which is subdivided for homes, 140 acres must be used for roads and open spaces such as parks or recreational areas. How many acres are remaining for home construction? If we subdivide this area into three lots per acre, how many homes can be built on one square mile?

RATIO, PROPORTION, PERCENT

*44. By the end of 1970, Americans will have discarded 50 billion tons of paper and 4 million tons of plastics.

a. If all this could be compressed into cubes one foot per dimension, weighing 50 pounds each, how many such cubes could be created at the end of 1970?

b. What might be a set of dimensions for a space large enough to hold this waste?

c. If 35% of all this waste could be recycled, (at present only about 10% of paper is being recycled) how many cubic feet of space would be saved?

d. How many pounds would be returned as a usable product? How many tons?

Suggestion: Find how many rooms the size of your classroom would be needed to contain this waste.

45. The population of the United States increased from 1960 to 1970 but not all the individual states gained.

State	Percent of gain from 1960 - 1970	1960 Population
Wisconsin	10.5	3,951,800
Alabama	3.3	3,266,700
Mississippi	-0.9	3,178.100
New York	7.1	16,782,300
North Dakota	-3.4	632,400
South Dakota	-2.8	680.514

a. Which state gained the most people?

b. Which state lost the most people?

c. Compute the 1970 population of Wisconsin.

d. Compute the 1970 population of Mississippi.

46. The population of Milwaukee in 1960 was 741,324; the figure for 1970 was 709,537.

a. This represents an (increase, decrease) of _____people from 1960 to 1970. Is this what you had expected the results to be? Why or why not?

b. Express this increase or decrease as a percent.

c. If the population of the United States was approximately 204,766,000 in 1970, the population of Milwaukee represents what percent of the total population of the United States?

d. The population of Wisconsin in 1970 was 4,418,000. This represents what percent of the total United States population?

47. The average amount of waste per person amounts to about 5 pounds per day. A major portion of this is paper products.

a. Make a list of paper products used in the home.

b. If the use of paper were suddenly restricted, what percent of these paper products could you get along without. (Paper towels, napkins could be replaced by cloth towels and napkins.)

48. In 1970, Americans bought 35,000,000,000 bottles (bottles are difficult for our environment to break down.) Of these bottles, only 10% are returnable. In 1970, 48,000,000,000 cans were used by Americans. (Note: aluminum cans don't break down.)

a. What is the ratio of bottles to cans (in lowest terms)?

b. The total number of bottles and cans in 1970 was 83,000,000,000. What percent of these is represented by bottles?_____ By cans?_____

49. In mid-1970 the human population of the earth was approximately 3.6 billion. The current growth rate of this population is 2% per year.

a. By mid-1971 the total world population was approximately _____ more than the mid-1970 population.

b. By mid-1971 the total world population will be approximately _____.

c. By mid-1972 the total world population will be _____. (Be careful!)

d. By mid-1974 the total world population will be _____. (Be careful!)

50. Thirty acres of land are planted with pine trees. Sixteen hundred trees are planted per acre. After two years 35% of the trees are cut in order to provide better growing conditions for the remaining trees.

a. How many total trees were planted on the thirty acre tract?

b. How many trees were eliminated by the two year cutting?

c. How many trees were left after the two year cutting?

51. The total population of the United States in 1970 was 204,766,000. In 1960 the population was 180,698,000.

a. There were _____ more people living in the United States in 1970 than in 1960.

b. The 1970 population represented an increase of _____% over the 1960 population.

52. More than one million motor vehicles were abandoned on the streets, alleys, vacant lots and highways of America in 1970. These vehicles only added to the 4 million vehicles already littering our land and another 8 million in junkyards. The number of registered autos, buses and trucks in 1970 was 108,977,000.

a. What was the total number of abandoned, junked, and unregistered vehicles littering our country at the end of 1970?

b. What is the ratio of these vehicles (part a) to the total number of registered vehicles (express in lowest terms).

c. Express the ratio in part (b) as a percent.

d. What is the ratio of abandoned vehicles to registered vehicles (express the ratio in lowest terms).

e. Express the ratio in part (d) as a percent also.

53. Private electric power companies spent over $200 million in 1969 to counter air pollution as against $127 million three years earlier.

a. This represents an increase of how many dollars over the former total?

b. This would be what percent of increase?

c. Have you noticed any difference in the past few years in the color of the smoke coming from the large power company smokestack? If so, what change have you noticed?

54. One study reveals that 95 million Americans drink water not meeting federal standards or of unknown quality. What percent of the United States population (using the figure 202,000,000) is drinking water that fits these conditions?

55. Americans in 1970 bought about 60 million tons of paper and plastic containers, and will discard 90% of it. This figure is increasing by 6% a year.

    a. How many tons of paper and plastic were discarded in 1970?

    b. How much increase will there be by 1971 in number of tons of paper and plastic?

    c. If the amount of these products thrown away also increases to 93%, how many tons of these products will be thrown away in 1971?

56. The Imperial gallon used in Canada is larger than the U.S. gallon. 10 Imperial gallons equal 12 U.S. gallons.

    a. 20 gallons of gasoline purchased in the U.S. would be equivalent to _____ gallons purchased in Canada.

    b. 30 gallons of gasoline purchased in Canada are equivalent to _____ gallons purchased in the U.S.

    c. Assume that the average motorist drives 11,000 miles per year and averages 15.6 miles/U.S. gallon.

        1. How many U.S. gallons of gasoline would be consumed by the average motorist in a year?

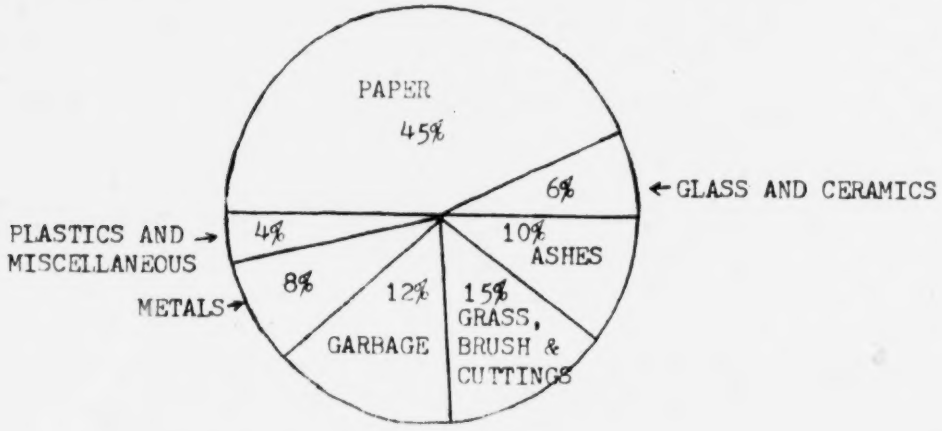
        2. How many Canadian gallons of gasoline would be consumed by the average motorist in a year?

57. The cost of waste collection and disposal currently in the United States is about 4 billion dollars annually, with 80% of this amount being used for collection purpose.

    a. How much money is used for collection?

    b. How much money is used for disposal?

58. The composition of solid wastes is constantly changing. Today it contains more and more synthetic materials. The average composition by weight is shown on the graph below.



If a large industrial firm produced 50 tons of solid waste in a one week period and all of the above components were present in the percentage shown, compute:

a. The number of tons of paper discarded.

b. The number of tons of grass, brush and cuttings discarded.

c. The number of pounds of ashes discarded.

If another, smaller industrial firm discarded 147 pounds of metals in a one week period: (Again assume that all the components were present in the percentage shown.)

d. Compute the total amount of solid wastes discarded by that firm in the one week period.

e. Compute the number of pounds of plastics and miscellaneous solid wastes discarded for that one week period.

59. During the year 1969, 1.2 million new customers were added to the electric utility industry bringing the new total to 70.9 million. In 1970 another 1.6 million customers were added.

a. How many customers were there in 1968?

b. How many customers were there in 1970?

c. What was the percent of increase from 1968 to 1969?

d. What was the percent of increase from 1969 to 1970?

e. To what reasons do you attribute this increase?

60.

	1964 POPULATION IN MILLIONS	GROWTH RATE
Costa Rica	1.4	4.3%
South Vietnam	15.9	3.7%
Belgium	9.3	0.5%
Hungary	10.1	0.4%

a. Using these figures, what was the population of Costa Rica in 1965?

b. Compare the increase in the population of Hungary to the increase in the population of South Vietnam. Which was less? By how many people?

The number of years it will take a population to double is dependent upon the rate of increase of the population. The following chart relates this information.

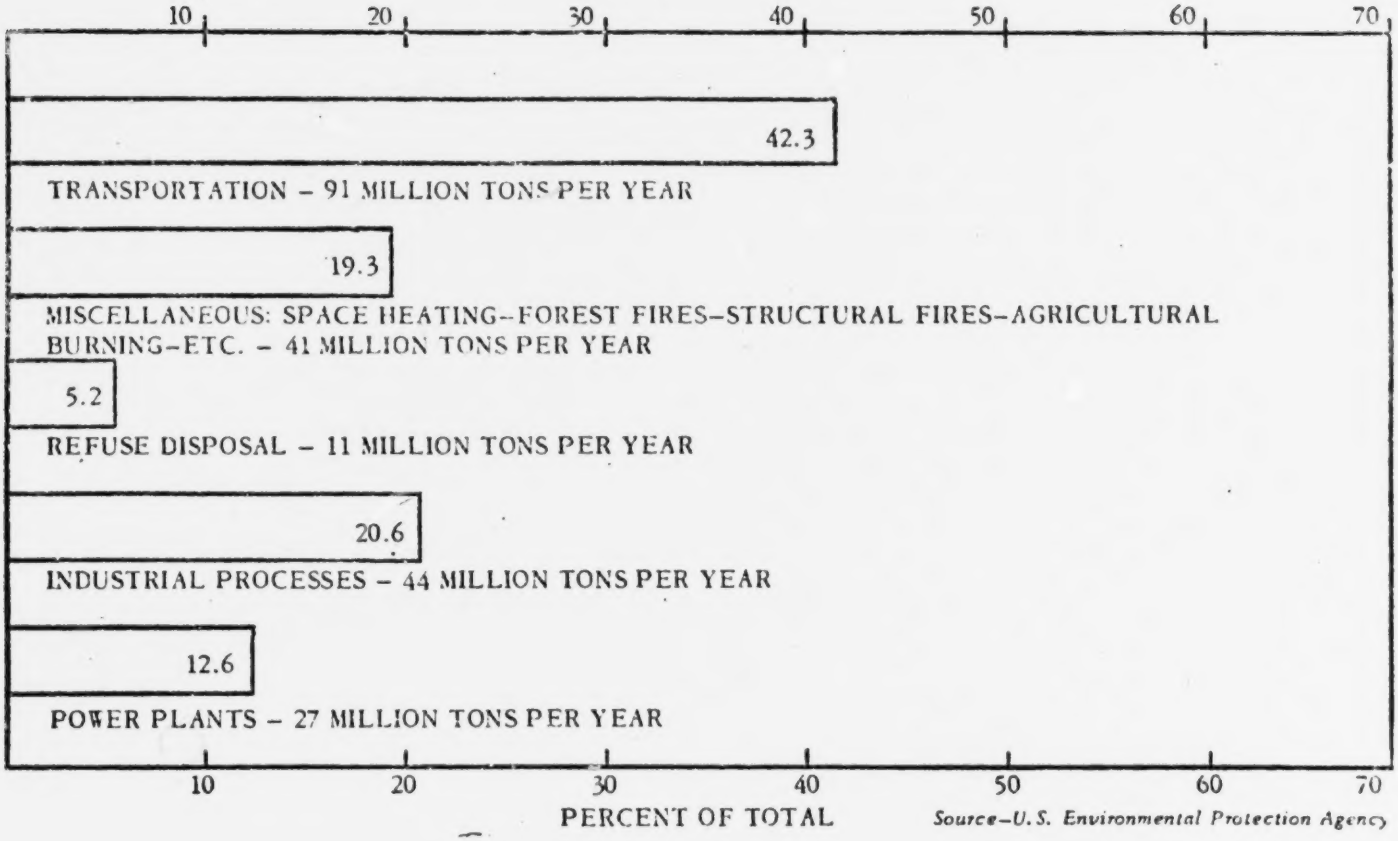
Rate of Increase	Years required to Double
0.5%	139
3.0%	23
3.5%	20
4.0%	18

c. Use the above information to estimate the doubling time for these four countries.

1. Costa Rica _____ Years
2. South Vietnam _____ Years
3. Belgium _____ Years
4. Hungary _____ Years

61.

NATIONWIDE INVENTORY OF
AIR POLLUTANT EMISSIONS
A TOTAL OF 214 MILLION TONS PER YEAR



Source–U.S. Environmental Protection Agency

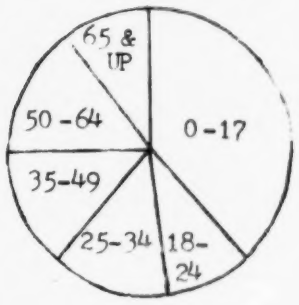
a. What is the total in tons of air pollutant emissions per year?

b. What percent of the total emissions is caused by transportation? By power plants?

c. The amount of pollution from refuse disposal is what percent of the amount of pollution from industrial processes?

GRAPHING AND STATISTICAL MEASURES

62. The circle graph, given below, represents the number of people in various age groups. It is based on the 1970 population figures.



Predicted Population in 1970. (By age)

a. Which age group represents the largest number of people?

b. Which is the smallest group?

c. What is the number of years contained in each group.

0 - 17 _____ 35 - 49 _____

18 - 24 _____ 50 - 64 _____

25 - 34 _____

d. Compare the 0 - 17 group to the group from 18 - 34.

1. Which is larger?

2. How many years in 18 - 34?

3. How do you think these groups might compare if the age span were the same?

e. Which of these represents the largest group of people, 0 to 34 or 35 and older?

63. The term "solid waste" describes that material which is solid and which arises from animal or human life activities and is discarded as useless or unwanted. This includes such items as garbage and other refuse materials. Below is a chart showing the approximate quantities of solid waste currently produced each year in the United States (based on a 1967 National Solid Waste Management Survey).

Waste	Number of Tons
Agricultural waste	550 million tons
Animal waste	1.5 billion tons
Industrial waste	110 million tons
Mineral waste	1.1 billion tons
Residential, commercial, and municipal waste	150 million tons

a. What is the total amount of solid waste produced each year? Express your answer in tons and pounds.

b. From which group do we get the greatest amount of solid waste per year? The least amount? Why do you think this is so?

c. Make a bar graph showing the above information.

64.

Steady Climb of Electricity Used In Homes* 1944 - 1969

Year	Average Number of Kilowatt - Hours Used Per Residential Customer	Average Revenue Per Kilowatt-Hour	Average Annual Bill
1969	6570	2.09¢	$137.31
1964	4701	2.30¢	108.12
1959	3618	2.51¢	90.81
1954	2573	2.70¢	69.47
1949	1684	2.95¢	49.68
1944	1151	3.51¢	40.40

(*Except Alaska and Hawaii. 1969 data includes Alaska and Hawaii.)
Source: EEI Statistical Year Book

a. Using this table prepare broken line graphs: (Colored pencils may be helpful)

   1. showing Year and Average Number of Kilowatt-Hours Used Per Residential Customer.

   2. showing Year and Average Revenue Per Kilowatt-Hour.

   3. showing Year and Average Annual Bill.

b. What has happened to the average number of kilowatt-hours used per residential customer in the past 25 years and why?

c. What has happened to the average revenue per kilowatt-hour in the past 25 years and why?

d. Compare the average annual bills in the past 25 years. What caused them to (increase, decrease)?

*65. Refer to the Milwaukee County pollution information below to answer the following questions.

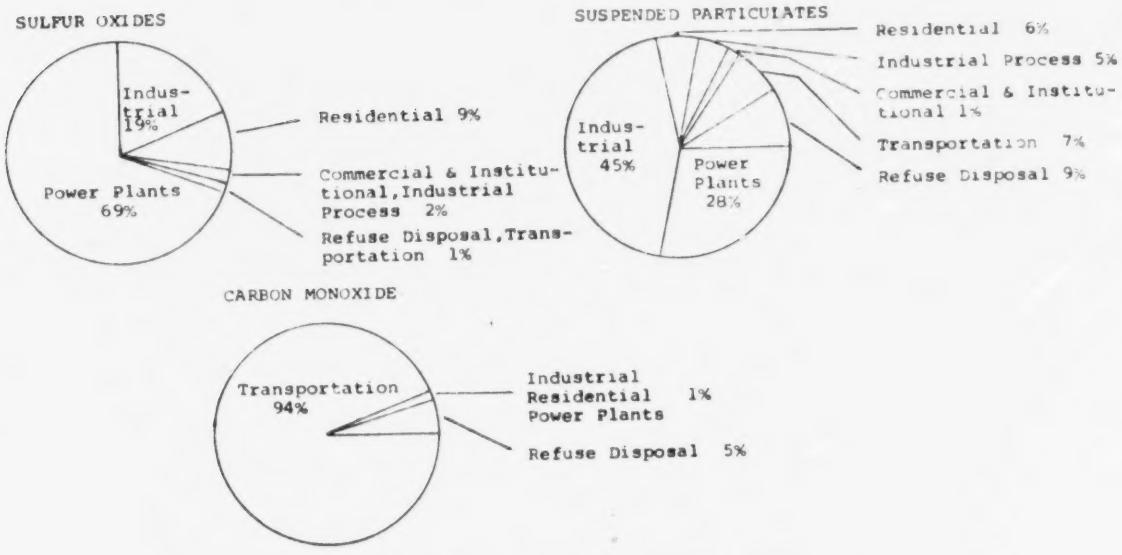
a. How many pounds of air pollutants were contributed by transportation in 1966?

b. What percent of the carbon monoxide polluting the air in 1966 came from refuse disposal?

c. What percent of the "suspended particulates" polluting the air in 1966 came from power plants?

d. Refuse disposal and transportation contributed what percent of the sulfur oxides polluting the air in 1966?

POLLUTION SOURCES



Major contributors to Milwaukee county's air pollution in 1966:

	Tons	Per cent
Transportation	432,386	53.2
Fuel burning (mostly heating)	93,270	11.3
Electric power generation	198,092	24.3
Solid waste disposal	32,408	4.0
Manufacturing and processing	57,968	7.2
Totals	813,125	100

Source: 1966 Pollution Source Emission Inventory for Milwaukee County.

*66. The average American uses 60 gallons of water per day in the home. The percentage breakdown is the following:

Flushing toilets	41%
Washing and bathing	37%
Kitchen use	6%
Drinking water	5%
Washing clothes	4%
Gen. household cleaning	3%
Watering the garden	3%
Washing the car	1%

a. Make a circle graph to illustrate the above information.

b. Make a bar graph to illustrate the above information.

*67. Americans throw away about 5 pounds of rubbish per person per day. Devise your own symbol and key to develop a pictorial graph showing the amount of rubbish disposed of in one week by:

a family of four
a family of ten
your class
teachers in your school
pupils in your school
etc.

68. The following data shows the general decline and the recent increase of the American forest acreage.

YEAR	APPROXIMATE FOREST ACREAGE
1600	1,030,000,000
1700	1,025,000,000
1800	1,000,000,000
1850	900,000,000
1900	800,000,000
1920	608.000,000
1940	771,000,000
1945	765,000,000
1960	773,400,000

a. Make a bar graph to show the changes in forest acreage over this time period.

b. From 1600 to 1850 the forest acreage (increased, decreased) by _____.

c. From 1940 to 1960 the forest acreage (increased, decreased) by _____.

d. What do you think accounted for the decrease in forest acreage between 1940 and 1945?

e. The forest acreage in 1960 was what percent of that in 1600?

69.

CUSTOMERS OF THE ELECTRIC UTILITY INDUSTRY*---1969

Classification	Number	Percent
Residential	62,598,910	88.3
Commercial	7,744,851	10.9
Industrial	348,648	0.5
Others	236,729	0.3
Total customers	70,929,138	100.0

*Including Alaska and Hawaii.
SOURCE: EEI Statistical Year Book

SALES OF ELECTRICITY IN 1969 BY CUSTOMER GROUPINGS*

Classification	Kilowatt-Hours In Millions	Percent
Industrial	557,220	43
Residential	407,922	31
Commercial	286,686	22
Others	55,350	4
Total	1,307,178	100

*Including Alaska and Hawaii.
SOURCE: EEI Statistical Year Book

a. Using the two charts given above, make a double broken line graph showing the percent of customers and the percent of sales. (Make both graphs on the same coordinate system, using colored pencils if possible.)

b. Although residential customers make up the largest percent of customers, they do not use the most kilowatt-hours. Why?

c. Make a circle graph or pictograph for the information above. (You may wish to graph only a portion of the information including sales and percent or customers and numbers.)

70. Air pollutants such as dust, soot, smoke, fumes, odors, fly ash and pollen are present every day in the air we breathe. This affects our daily activities such as baseball, tennis, swimming, picnicing, boating, etc. Below is a table showing air pollution in different areas.

SUSPENDED PARTICLES-MICROGRAMS PER CUBIC METER

Location	Annual Average
Kenosha, Wis.	60
Pittsburgh, Pa.	161
Door County, Wis. (rural)	26
Madison, Wis.	84
London, England	211
Superior, Wis.	70
Chicago, Ill.	148
St. Louis, Mo.	150
Milwaukee, Wis.	126
Hudson, Wis.	40
New York City, N.Y.	188
Racine, Wis.	60
Eau Claire, Wis.	65

a. Which location has the least amount of suspended particles in its air? Which area has the most suspended particles? Are these the type of results you would expect to get? Why or why not?

b. List the locations in order (least to greatest) according to air pollutants in the atmosphere.

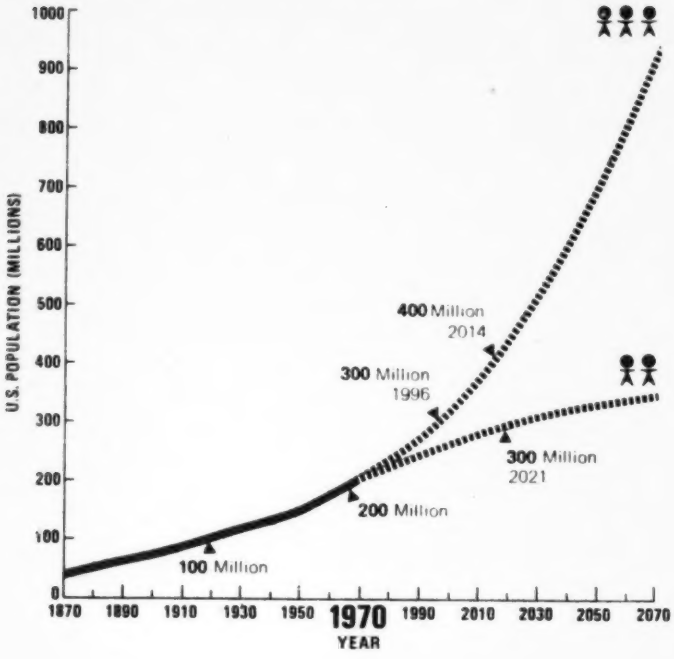
c. Make a bar graph from the table above plotting location on the vertical (y) axis and suspended particle matter on the horizontal (x) axis.

d. What is the mean weight of suspended particles for the above locations? (The arithmetic average is called the mean.)

e. What is the median for the above locations? (Median is defined to mean the middle score in a distribution of scores from lowest to highest.)

71.

WILL THE U.S. ADD A FOURTH 100 MILLION TO ITS POPULATION?
EFFECT OF 3-CHILD FAMILY vs. 2-CHILD FAMILY.



Taken from: Population Growth And America's Future - An Interim Report to the President and the Congress from the Commission on Population Growth and the American Future, Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402

a. In what year was the U.S. population about 100 million?

b. What was the approximate population in 1970?

c. In the 2030, what will the population be if the average family has 3 children?

   If the average family has 2 children?

d. What is the difference between the two totals?

A N S W E R S

PROJECTS AND ACTIVITIES

1. Answers will vary

2. a. 109,000,000/410,000,000.00 = 3.76 pounds/year

```
          3.76
      ------------
410,000,000.00
327,000,000
 83,000,000 0
 76,000,000 0
  6,700,000 0
  6,540,000 0
    16,000,000
```

   b. 205,000,000/410,000,000 = 2 pounds/person

```
          2
      ----------
410,000,000
410,000,000
```

   c. 410,000,000 X 2 = 820,000,000 pounds

3. Answers will vary

4. Answers will vary

5. Answers will vary

6. Answers will vary

7. Answers will vary

8. Answers will vary

9. a. 8 sq. ft./student

   d. 2 days, 1 day

10. Answers will vary

11. a.

	Birth Rate	Death Rate	Nat. Increase
Madison	18 per 1000	6 per 1000	12 per 1000
Wausau	18 per 1000	10 per 1000	8 per 1000
Green Bay	19 per 1000	8 per 1000	11 per 1000

11. cont.

b. 1. 4.5%

2. 34 per 1000

3. 3.4%

4. 10,710 births

c. 1. 3.6684 billion or 3,668,400,000

3.7365 billion or 3,736,500,000

d. 1. 384,000,000

2. 160%

12. Answers will vary

PUZZLES

13. 25

14. 252

15. can

16. noise polluter - Howard

water polluter - Robert

land polluter - Tom

air polluter - Andrew

WHOLE NUMBERS

17. a. 24 x 60 x 21 = 30,240 bags

b. 30,240 x 50 = 1,512,000 lbs.

c. 1,512,000 ÷ 2,000 = 756 tons

d. 20,000 x 2,000 ÷ 50 = 800 bags

18. a. 150 x 1,085,000 = 16,275,000 gallons

    b. 185,000,000 - 16,275,000 = 168,725,000 gallons

    c. 15,000,000 gallons

19. 87

20. The effects would be with us through 1985 and therefore we should be freed of its affects (in theory) by 1986.

21. 2x 263 = <u>526</u>, 526 x 2 = <u>1,052</u>, 1052 x 4 = <u>4,208</u>

22. a. 10 x 36.5 x 5 = 1,825

    b. 20 x 36.5 x 5 = 3,650

23. 50 billion x 3 = 150 billion

24. Class of 35 pupils

    5 x 35 x 365 = 63,875 lbs./year

25. a. 2,000,000 ÷ 24 = 8,333.33 barrels

    b. 2,000,000 ÷ 2 = 1,000,000 barrels

    c. 2,000,000 x 7 = 14,000,000 barrels

    d. 2,000,000 x 30 = 60,000,000 barrels

26. a. 1,800,000 + 750,000 + 400,000 = 2,950,000 tons

    b. 5,900,000 lbs.

<u>RATIONAL NUMBERS (FRACTIONS)</u>

27. a. $\frac{60}{75}$ = 8/min.

    8 x 60 = 480/hr.

    480 x 24 = 11,520/day

    11,520 x 7 = 80,640/wk.

    80,640 x 30 = 2,419.200/mo.

    2,419.200 x 12 = 29,030,400/yr.

27. cont.

b. $10,150 \div 70 = 145$ lbs./yr.

$\frac{145}{365} = \frac{29}{73}$ lb./day

c. $10,150 \div 900 = 11.28$ cows

d. $28,000 \div 70 = 400$ lbs./yr.

$\frac{400}{365} = \frac{80}{73} = 1\frac{7}{73}$ lbs./day

e. $26,000 \div 70 \times 2,000 = 74,260$ lbs./yr.

$\frac{74,260}{365} = 203.45$ lbs./day

28. $\frac{1}{2} \times 4 \times 24 \times 7\frac{1}{2} = 360$ ($7\frac{1}{2}$ gal. = 1 ft.3)

4 - 15 min. period/hr.

29. $\frac{2}{3} \times 3\frac{1}{2} = 2\frac{1}{3}$ billion

30. a. $\frac{400}{365} = \frac{20}{34} = \frac{10}{17}$

b. $\frac{280}{680} = \frac{28}{68} = \frac{7}{17}$

c. $\frac{2}{3} \times 400 = 266\ 2/3$ sq. miles

d. $\frac{1}{2} \times 266\ 2/3 = 133\ 1/3$ sq. miles

31. a. $\frac{1}{200}$ or one care for every 200 people

b. $\frac{35}{100} = \frac{7}{200}$ - 7 cars for every 200 people

c. $4 \times 1,800 \div 200 = 36$ cars abandoned

d. $4 \times 1,800 \div 20 \times 7 = 2,520$ cars disposed of

32. a. $\frac{10}{110} = \frac{1}{11}$ of population

b. $\frac{1}{2} \times 90{,}000 = 45{,}000$

c. $\frac{2}{3} \times 780{,}000 = \begin{matrix} 520{,}000 \text{ lost} \\ 260{,}000 \text{ remaining population} \end{matrix}$

33. a. 64 babies

b. 2,000 babies

c. $\frac{1}{3} \times 2{,}000 = 667$ mature rats

d. $\frac{5}{8} \times 667 = 415$ females

e. $415 \times 5 \times 20 = 41{,}500$ babies

34. a. $73{,}728 - 41{,}086 = 32{,}642$

b. $\frac{73{,}728}{3{,}577{,}016} \quad \frac{X}{100}$; 2%

$\frac{41086}{1915452} = \frac{X}{100}$; 2.1%

c. 17, 9.4

d. 7.6

RATIONAL NUMBERS (DECIMALS)

35. Hour $88 \times 60 = 5{,}280$ lbs. $\frac{5{,}280}{2000} = 2.64$ tons

Day $88 \times 60 \times 24 = 126{,}720$ lbs. $\frac{126{,}720}{2.000} = 63.36$ tons

Week $7 \times 88 \times 60 \times 24 = 887.040$ lbs. $\frac{887{,}040}{2.000} = 443.52$ tons

Month (30 days) $30 \times 88 \times 60 \times 24 = 887.040$ lbs.

$\frac{3801{,}600}{2.000} = 1{,}900.8$ tons

Year (365 days) $365 \times 88 \times 60 \times 24 = 46{,}252{,}800$ lbs.

$23{,}126.4$ tons

36. a. $\frac{28.150}{200} = 14.075$ tons

b. $28150 \div \frac{12}{16} = 37{,}533.3$ servings

37. a. 205 million x 470 = 9,635,000,000 lbs. of paper

b. $205 \div 6 = 34.1667$

38. a.

0	hour 0	$2\frac{1}{2}$	hour 31
$\frac{1}{2}$	hour 1	3	hour 63
1	hour 3	$3\frac{1}{2}$	hour 127
$1\frac{1}{2}$	hour 7	4	hour 255
2	hour 15	$4\frac{1}{2}$	hour 511
		5	hour 1023

b. $\begin{array}{r} 0.003 \\ \hline 1024 \\ \hline 3.072 \end{array}$

39. a. $(5280)^2 = 27{,}878{,}400$

b. $30 \times 2000 = 60{,}000$

c. $60{,}000 \times 16 = 960{,}000$

d. $\frac{960{,}000}{27{,}878{,}400} = .0344352$

40. a. $26 + 12 + 15 = 53$ billion min.

$29 + 15 + 15 = 59$ billion max.

b. $\frac{53{,}000 \text{ million}}{210 \text{ million}} = \$252.38$ person min.

$\frac{59{,}000 \text{ million}}{210 \text{ million}} = \$280.95$ person max.

PERIMETER, AREA

41. a. $6 \times 5280 = 31,680$

b. $31,680 \div 3 = 10,560$

c. $31,680 \times 200' = 6,336,000$ sq. ft.

d. $6,336,000 \div 9 = 704,000$ sq. ft.

e. $31,680$ ft. $\div 40$ ft. $= 792$ lots $\times 2 = 1584$ lot/strip

$1584 \times 5 = 7920$ people

42. a. $\frac{20,000}{1,400}$ 14 T (round off to nearest ton)

b. 1 sq. mile = 144 city blocks

$\frac{20,000}{1400 \times 144} = .097$ T (approx.)

c. $\frac{20,000}{1400 \times 144} \times 2000 = 194$ lbs./city block (approx.)

43. 640 acres = 1 sq. mile, $640 - 140 =$ 500 acres

$500 \times 3 = 1,500$ homes

RATION, PROPORTION PERCENT

44. a. $\frac{(50,000,000,000 + 4,000,000) \times 2,000}{50} = 2,000,160,000,000$ cubes

b. $\sqrt[3]{2,000,160,000,000} \times \sqrt[3]{2,000,160,000,000} \times \sqrt[3]{2,000,160,000,000}$

c. Waste is defined to include paper and plastic.

$\frac{50,004,000,000 \times 2,000}{50} \times \frac{35}{100} = 700,056,000,000$ cu. ft.

d. $700,056,000,000 \times 50 = 35,002,800,000,000$ lbs.

$\frac{35,002,800,000}{2000} = 17,501,400,000$ tons

45. a. New York

b. North Dakota

c. 4,366,739 Wisconsin

d. 2,158,497.1 Mississippi

46. a. 31,787 decrease

b. $\frac{31,787}{741,324} = .043 = 4\%$

c. $\frac{709,537}{204,766,000} = .0035 = .35\%$

d. $\frac{4,418.000}{204,766,000} = .021 = 2.1\%$

47. Answers will vary

48. a. $\frac{35,000,000,000}{48,000,000,000} = \frac{35}{48}$

b. $35 \div 83 = .42 = 42\%$ bottles, 58% cans

49. a. .072 billion = 72,000,000 more

b. 3.6 + .072 = 3.672 billion = 3,672,000,000

c. .07344 billion more people = 3,745,440,000 total

d. 1973 population = 3,820,528,000
1974 population = 3,896,938,500

50. a. 1600 x 30 = 48,000 trees

b. 48,000 x .35 = 16,800

c. 48,000 - 16,800 = 31,200 trees left.

51. a. 204,766,000 - 180,698,000 = 24, 068,000

b. $\frac{24,068,000}{180,698,000} = 0.1331 = 13\%$

52. a. 13 million

b. $\frac{13 \text{ million}}{108,977 \text{ million}} = \frac{13,000}{108,977}$

c. .119 = 12%

d. $\frac{5,000}{108,977}$

e. .082 = 8%

53. a. 200 - 127 = 73 million

b. $\frac{73 \text{ million}}{127 \text{ million}} = .5748 = 57\%$

c. _____

54. $\frac{95 \text{ million}}{202 \text{ million}} = .47 = 47\%$

55. a. 54,000,000 tons

b. 3.6 million tons

c. 59.148 million tons

56. a. $\frac{10}{12} = \frac{X}{20}$ X = 16 2/3 gallons

b. $\frac{10}{12} = \frac{30}{X}$ X = 36 gallons

c. 1. 705.13 U.S. gallons

2. 587.6 Canadian gallons

57. a. $\frac{80}{100} = \frac{X}{4,000,000,000}$ X = $3,200,000,000

b. $4,000,000,000
$- 3,200,000,000$
$800,000,000

58. a. 45% x 50 tons = 22.5 tons paper

b. 15% x 50 = 7.5 tons

c. 10% x 50 x 2,000 = 10,000 lbs.

d. 8% x _____ = 147 1,837.5 lb total/wk.

e. 4% x 1,837.5 = 735 lbs.

59. a. 69.7 million

b. 72.5 million

c. $\frac{\text{Increase}}{1968} = .0172 = .02 = 2\%$

d. $\frac{\text{Increase}}{1969} = .0165 = .02 = 2\%$

60. a. 1,460,200 people

b. Hungary increases by 40,400
South Vietnam increases by 583,300
Difference = 542,900

c. 1. Approximately 17 yrs.
2. Approximately 19 yrs.
3. Approximately 139 yrs.
4. Approximately 140 yrs.

61. a. 214 million tons/yr.

b. $\frac{91}{214} = \frac{X}{100}$ or 42.3%

$\frac{27}{214} = \frac{X}{100}$ or 12.62%

c. $\frac{11}{44} = \frac{X}{100}$ or 25%

GRAPHING AND STATISTICAL MEASURES

62. a. 0-17

b. 65 and up

c. 0-17 = 18 25-34 = 10 50-64 = 15

18-24 = 7 35-49 = 15

d. 1. 0-17

2. 17 yrs.

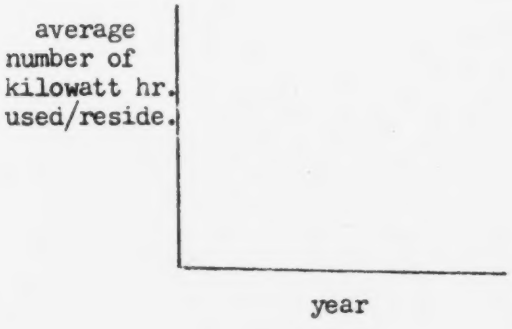
3. Answers will vary

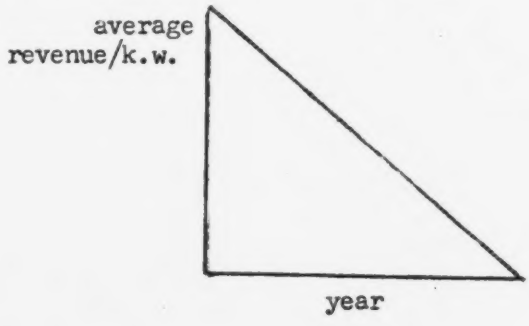
e. 0-34

63. a. 550,000,000 + 1,500,000,000 + 110,000,000
+ 1,100,000,000 + 150,000,000 = 3,410,000,000 tons

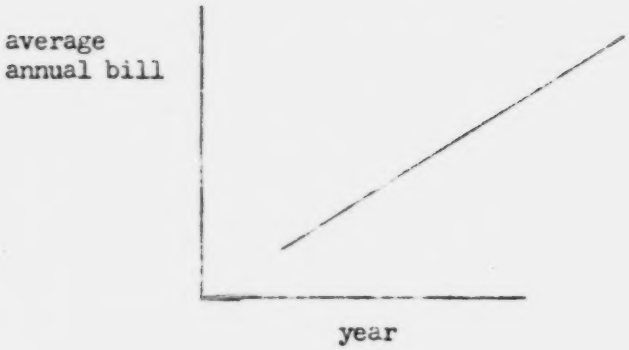
b. Greatest - animal waste
Least - industrial waste

64. a.





64. cont.



b. The number has gone up due to the increased use of electricity and many more appliances in the home.

c. It has gone down due to increased efficiency of power utilities.

d. Increase - more appliances and greater use of electricity.

65. a. 864,772.000 c. 28

b. 5 d. 1

66.

67.

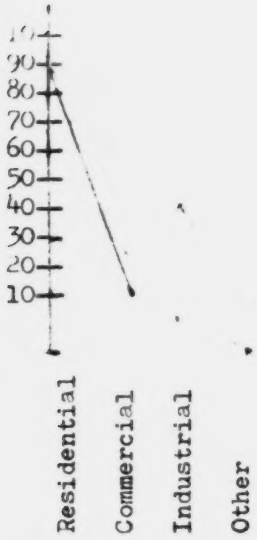
68. a.

b. 1.030 million - 900 million = 130 million decrease

c. 2.4 million increase

d.

e. $\frac{773,400,000}{1,030,000,000} = .7508 = 75\%$



B. Because industries with their large and great number of machines, generators, transformers etc. running usually 24 hours a day require greater amounts of electricity then do the industrial customers.

70. a. Door County; London, England

b. Door County (rural) Wis.
Hudson (rural) Wis.
Racine, Wis.
Kenosha, Wis.
Eau Claire, Wis.
Superior, Wis.
Madison, Wis.
Milwaukee, Wis.
Chicago, Ill.
St. Louis, Mo.
Pittsburgh, Pa.
New York City, N.Y.
London, England

c.

d. 60 + 161 + 26 + 84 + 211 + 70 + 148 + 150 + 126 + 40 + 188 + 60 + 65 = 1,389 1,389 ÷ 13 = 106.84615

e. 84

71. a. 1920

b. 200 million

c. 1. 500 million
2. 300 million

d. Approximately 200 million